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De-regulations double

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De-regulations Double: Arups, Fire Safety and the Meta-engineering of Architectural Practice.

1. From 'Total Design' to Meta-Engineering

They're the people you go to when you want to know how quickly you can dismantle the wreckage of the World Trade Centre, and dump it in the New Jersey Meadowlands; by modelling the heat of the inferno, and the thermal capacity of the structural steels, they can estimate the current temperature of each member, its likely rate of cooling, and the date on which it will be safe for the wrecking-crew to handle it. They're also the people you go to when you want to know what time of day to erect the CCTV building; the structural steels have been left out in the sun, subject to variable solar gain, but by calculating the differential expansion of each member, they can tell you which ones need to be coupled at dawn, when they're both cool.

These calculation may be the stock-in-trade for engineers at Arup's Associates - the worlds biggest building-design consultancy - but if we trust Rem Koolhaas, they are also indicative instances of the 'post-modernity' of contemporary engineering. Koolhaas suggests that, through their fastidious devotion to the empirical – enabled and mediated by the 'hypnotic window' of the computer – these engineers have abandoned any modernist concern for universalizing structural principles, or their didactic expression: *"once avid supporters of High Tech, modernism's moment of decadence, [Arups are], - in a form of emancipation - now exploring a kind of science fiction, meta-engineering as a total answer to everything"*ⁱⁱⁱ. The meta-project which Arup's have been pursuing in the background of architectural culture is the de-construction of every structural or architectural principle, by assuring us that anything and everything is (technically) possible.

This extension of Arup's 'Total Design'ⁱⁱⁱ into 'meta-engineering'ⁱⁱⁱ is given more substance by Arindam Dutta's article 'Marginality and Meta-engineering: Keynes and Arups'^{iv}. Again noting the way that the firms work has charted a loss of faith with concerns for structural 'honesty' or 'economy' – which Dutta associates with classical economic concepts of 'thrift' – he suggests we understand Arup's recent work as the realization of Keynesian economic and aesthetic principles. The global rash of 'signature' architectural projects Arup's delivered during the nineties and noughties were, at the economic level, targeted stimuli by Sovereign wealth funds occupying the vacuum of public dis-investment. But Dutta suggests that the sheer structural extravagance of these buildings (in the UK we might think of those Lottery-funded projects of the period – the Eden Project, the Lowry Museum, the London Eye, the ArcelorMittal Orbit) did more than simply represent the calculatedly irrational optimism of Blairite economics; it was also a means for Arup's to re-engineer the legislative framework of building practices. Dutta shows how in order to deliver these projects, Arups extended its services from those of mere engineering, to include development accountancy, international legal-advice, and even the review and drafting of governmental legislation. The *object* of design for these engineers, according to Dutta, is no longer the building as such; rather,

buildings simply represent the “‘front end’ of an infrastructural project whose impetus is to transform the modalities of governmentality as such”^v.

This talk continues the line of thought outlined here by Koolhaas and Dutta considering the initiatives of Arup’s Associates to re-engineer the conditions of contemporary architectural and governmental practice. Its specific lens is a sub-field of consultancy offered by Arups, that of fire-safety engineering. It seeks to show how Arup’s have been instrumental in the development of this new discipline; to illustrate how the rationalities of this discipline have been shaped by the concerns of contemporary building design; and so to show how concerns of building design have in turn become drivers within a re-engineering of broader legal and political framework. That is, the talk suggest that specific modernist architectural motifs – the open plan, the exposed structural frame – have become actors within a set of governmental transformations we recognize as part of the neo-liberal turn; the deconstruction of the state and its replacement with marketized services; the collapse in universalist social security through the concept of individualized risk; and the replacement of transparent knowledge frameworks with conditions of ‘creative’ uncertainty.

2: From Technologies of Solidarity to Technologies of Speculation

The problem of fire offers, of course, an important historical link between questions of governance and questions of architectural design. In the UK, for instance, the Great Fire of London is often cited as the focusing event that necessitated our first building regulations. More broadly, though, we could say that the experience of urban fire has been an important legitimator of governmental action, and one that has led to the gradual collectivization of risk through specific technologies of ‘solidarity’^{vi}. In rural pre-reformation Scotland fire was generally understood to be a matter of personal responsibility, if not divine retribution, and it was only the intensification of risk through urban settlement that generated a call need for regulation. In 1426 James I imposed a curfew (*couvre-feu*) on the city of Edinburgh, banning the carrying of fire by night, and stopping ‘common women’ entering the city (the untended fires of aroused men were understood to be the source of inflammation in this Calvinist govern-mentality). By the 17th Century, Scotland’s Royal Burgh’s were fully established as legal and responsibility-bearing agents, and in Edinburgh instituted the first building codes as a means to limit vertical spread of flame, at the same time as developing the cities first “Company for Quenching Fires”. During the 18th Century, the birth of the Insurance industry drove innovation in the field, through commercial risk-spreading societies and associated private-enterprise brigades. But by the early 19th C. this privatized system had come to be seen as counterproductive - uninsured buildings could not be allowed to burn unchecked – and in 1824 Edinburgh established the UK’s first full-time municipal fire-fighting service, empowered to grant permission for building designs on the basis of fire-prevention and rescue. By the 20th C, through the conscription of fire-fighters within WWII, and the industrialization of post-war reconstruction, the fire-services and building regulatory frameworks were made national and mandatory.

Arguments for the *de-regulation* of fire-safety knowledge were developing in parallel to the birth of these universalizing standards, however. It was recognized by both the government and the scientists of the day that existing codes and standards were a patchwork of reactive regulations, based on the often arbitrary contingencies of past events: The British Standards for safe egress time, for instance (which determine the size of any single 'compartment'), insist that occupants should be able to escape from a building in the duration of the British National Anthem, due to a single well publicized fire in which 3000 theatre-goers reportedly escaped while the band played; the British Standard Fire Test, used to determine the amount of fire-protection required around a structure, is based on the progress of a blaze measured in the fire-box of a Victorian steam-locomotive, an index of the speed in which Navvies can shovel coal, but completely unrepresentative of any building fire^{vii}. Recognising that future construction should not be hindered by the arbitrary details of past fires, the UK government set up the Fire Research Station at Borehamwood in 1949. The ambition of the Station was to develop a scientific basis for the modelling of fire behavior, and its work provided the basis for the development of Fire Safety Engineering as both an academic discipline and a field of consultancy. David Rasbach, who began his career at Borehamwood, established the world's first Fire Safety Engineering programme at the University of Edinburgh. Margaret Law, a colleague of Rasbach's, established the world's first fire-safety consultancy with Arups.

Law was influential in establishing the productive tension that exists between the rationalities of fire-safety science, and those of fire-safety regulation. In *'Magic Numbers and Golden Rules'* she outlines her critique of existing prescriptive standards, both on the basis of their arbitrary science, but also for concealing lazy government-mentalities: *"the regulatory authorities are comfortable with [these] magic numbers. If the distance to a door is no more than 45 m, the building is safe. They need to think no further."* The regulatory attitude also brings – in Law's account – a risk-averse restrictive texture to academic research: *"the transfer of technology from the researcher to the real world is subject to a ratchet mechanism. Because fire research is almost entirely bound up with safety issues, there is an inherent prejudice in favor of releasing and applying results at the earliest stage if lives can thereby be saved..."* while no such pressure exists to disseminate *"research carried out which shows that the current approaches to fire safety may be overly restrictive"*. To counter these perceived problems, she argues for a fire-safety science whose principle aim is to *de-regulate* fire-safety thinking, basing it on empirical, performance-based calculations, that facilitate design flexibility: *"as soon as [rules] frustrate design, we should be able to re-establish the rationale behind the rules and thereby develop new approaches"*. Echoing Arup's own notion of 'Total Design' Law argued against the establishment of universal standards for safety, and for a flexible empirical approach that would allow safety to be understood as another design case-load, balanced against financial, political or aesthetic concerns.

[3. The Political Economy of Exposed Structural Steel](#)

[We can understand how the intersection between architectural and governmental thinking developed through the emergence of fire-safety engineering](#)

by looking at a sequence of influential projects from the perspective of fire-safety, and considering the way in which their design innovations drove changes in the legislature.

As recently as the 1960's, the rationalities of fire-safety seemed quite anathema to those of architecture. Mies' Seagram building (1958) – and all of his later American corporate projects – realized their ambitions for aesthetic simplicity and structural honesty through the application of stuck-on decorative columns, so inconceivable was it to have a unprotected structural steel frame. However, by the 1970's, with Margaret Law installed at Arups, this changed. Law developed means to achieve required fire ratings through the massivity of structural members, and through water-cooled hollow-sections, and she deployed both of these strategies at the Pompidou Centre (1971-77). At Beauborg, Law also used the offset of structure from envelope as a fire-safety strategy; the Pompidou's water-cooled compression columns are set 1.6 metres outside of the glazing, with the slender tensile members pushed a further 7.6 metres by the massive 'petit gerberettes' (Law frustrated Piano and Rogers ambition for a totally open and flexible interior space, however; recognizing that members close to the window would be lost in a fire, each floor had to be divided into two fire-compartments to minimize loss of structural stability). Arups pushed this logic further in a parallel project, Bush Lane House (1971-74), for which it was also the Architect, where the whole primary structure is pushed out-board of the envelope, leaving open and uncompartimentalised interior floorplates.

The 1980's brought two developments which put Fire Safety Engineers in more general demand. Thatcher's de-regulation of the financial services sector – her 'Big Bang' – created an enormous demand for office space within the City of London. The fashion for Atria within these building brought about a commensurate de-regulation of aspects of architectural design, presenting legislators with challenges for which they did not yet have rules. At Lloyds of London (1978-86) – where structural concrete was still required so as to avoid fire-protection to the exposed interior frame - Arups pioneered the use of Computational Fluid Dynamics to model smoke and fire behavior within the Atrium, and so gain relaxations on the requirement for compartmentation. The professional regulatory context was also shifting, with the Monopolies and Mergers commission and the later Warne Report disbanding architects fee scales and protection of function. The development of Design and Build contracting opened up new forms of procurement within which the architect was no longer needed as lead designer, and in which engineers might take the role of lead designer. Due to their ability to relax or contravene regulatory requirements, Firms offering Fire-Safety consultancy developed a significant market advantage. The ability to design large open-plan structures with exposed structural steel offered significant cost saving in the context of warehouse design, and became key design-drivers within ambitions to 'Value Engineer' such structures.

In the 1990's and early Noughties, as we have noted, Arups established a reputation as a delivery firm for international projects by 'signature' architectural firms. The self-consciously transgressive architectural proposals of Gehry, Hadid, Koolhaas et al provided design challenges which further critiqued existing regulatory frameworks, securing the apparent demand for a performance-based approach to safety. The Seattle Central Library – in which Koolhaas deployed his ironically compliant technique of pushing the building volume to the maximum permitted by

zoning regulation – he nonetheless broke all of Seattle codes for egress, compartmentation and smoke control. Again, detailed computational fire-scenarios were required to demonstrate the safety of the interconnected public volumes.

The aesthetic/economy of large open-plan spaces and unprotected steel structures reaches its point of clarity, though, in a series of office projects in London in the early 2000's. Plantation Place (2004), which has completely unprotected structural steel and unimpeded floor plates, was the first project to gain regulatory approval through the use of Dynamic Fire modelling, a computational system for modelling the way fire moves around a structure, and depending on the fire load, burning out before reaching the heat required to melt structural steel. This method was developed by Arup's and The University of Edinburgh as a means to replace the British Standard Fire Test, changing the regulatory framework from one based on a normative case, to one which requires bespoke modelling of every project. The Heron Tower (2007-11), which again uses unprotected structural steel throughout, also introduces new modes of fire simulation into our regulatory frameworks. Being in the design stages while Arup's and the University of Edinburgh were conducting forensic research into the structural failure of the World Trade Centre, Arup's used that research to demonstrate the ability of a building to withstand a fire distributed across multiple floors – something not previously considered by regulators – to argue for the Heron Tower's innovative three-storey sky-lobbies. The realization of these projects was only possible through the restructuring of existing legislation, via close collaboration between Arup's, the City of London, and its fire services. Eager to ensure that the Square Mile retains its particular economic competitiveness, the City of London were happy to require that its fire-services undertake secondments with Arups to ensure they understand the complexity of fire-safety solutions undertaken in these projects, and have changed their regulatory structures to no longer require adherence to conventional fire-safety standards, but make the forms of computational analysis pioneered by Arups mandatory on all scheme.

4. Engineering (in) Reflexive Modernity

This story is, on the one hand, a simple one of the apparent success of Arup's Total-Design, demonstrating examples of the way in which architectural, engineering and governmental thinking have increasingly converged around concrete design challenges. However, on the other, it appears to demonstrate troubling counterproductivities and reflexivities. The initial promise of Fire Safety Science was to deliver us from the arbitrary rules of prescriptive regulation, by creating a more empirical basis for the definition of 'safety'. However, this has not been achieved. Fire Safety Science has not re-defined our concepts of safety. Engineers have developed a reputation as Value Engineers precisely because they have worked to remove safety features from buildings, making empirically less safe structures.

Counter to easy divisions of modernism/postmodernism, what I hope this story offers is an insight into the way in which architectural motifs that we might consider 'modernist' have supported and been realized through governing-mentalities we associate with post- or reflexive-modernities.

The integrated design thinking organized around ambitions for structural expression and spatial openness have, through Fire-Safety Engineering, become materially associated with initiatives to shift the locus of governmental expertise away from the state, and toward more autonomous and less accountable institutions of academia and international design consultancy.

In doing so, they have supported discourses which have sought to dismantle universalist notions of social security, and have promoted cultures within which individuals and organisations are financially incentivised to consider their own particular 'risk profiles' and to see safety as part of a set of financial and economic speculations against which there are opportunities for competitive advantage and profit.

Together, this has supported the re-structuring of building designs regulatory frameworks which, while purporting to bring enhanced safety to buildings and more scientific rigor to governance, has in fact worked to legitimate the design of increasingly more hazardous buildings, and to obscure our definitions of safety, construct new opportunities for design innovation within structured inequalities of knowledge.

Counter-productivity of Fire Safety Engineering. Failing to deliver safer buildings. Rather, in terms of the buildings it creates, managing to stretch margins of safety in order to deliver cheaper projects, or more accurately realize architects ambitions. Rather than develop more empirical definitions of safety, its work involves imaginative ways of working creatively within existing margins of safety, creating the ability to design trade-offs which work within a context of uncertainty. Rather than achieve a more robust regulatory framework, UoE and Arups work is pushing toward greater de-regulation, to the recognition of 'Safety' as a design-load factor.

Obvious individual academic and economic self-interests here, but these developments also follow broader governmental logics. Meta-engineering of regulatory context, Arups is furthering the devolution of government, away from the instruments of state, and toward the parastatal bodies of Universities and international corporations (much as Keynes suggested devolution of fiscal control away from government?). By suggesting we think of Safety as a 'design load', a commodity we may wish to have more or less of, feeds into two contemporary questions of subjectification; What Foucault would call governmentality of 'security', whereby our individual feelings of insecurity are harnessed as a mode of subjectification, but also a trend toward the marketised and speculative; working as clients or designers within this de-regulated context we are no longer confronted with blanket safety requirements, but given the opportunity to situate ourselves and our building occupants on 'risk spectrums'.

Meta-engineering of FSE is geared towards creating a kind of productive uncertainty, that operates technically and architecturally, economically, but also subjectively.

ⁱ Rem Koolhaas and Office for Metropolitan Architecture, *Content* (Köln: Taschen, 2004).

ⁱⁱ Arups notion of 'Total Design' refers to his ambition to think beyond the opposition of engineering and architecture, which had been formalised legally in the UK in 1918, 5 years before Arup's arrival. The ambition to find synergies between architectural and engineering thinking has a chequered history in Arup's own portfolio; projects such as the Sydney Opera House, for instance, could be seen as evidence either for or against this ambition. This paper suggests – in a way that echoes Duta's work – that the history of the firm's work provides a kind of 'working through' of the ambition to dissolve the relation between the two disciplines, one which has sometimes contradictory results. See 'Engineering Timelines - Ove Arup - Total Design', accessed 28 February 2016, http://www.engineering-timelines.com/who/arup_O/arupOve11.asp.

ⁱⁱⁱ The notion of meta-engineering is was perhaps first defined by Dennett in the context of cybernetics and theories of evolution. Dennett defines the term as "*the investigation of the most general constraints on the processes that can lead to the creation and reproduction of designed things*". It therefore connotes, not the design of things, but the design of designing methods, as well as the design of the conditions of applicability for designed products. Daniel C. Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life*, New Ed edition (Penguin, 1996).

^{iv} *Governing by Design : Architecture, Economy, and Politics in the Twentieth Century / Aggregate ; Contributors, Daniel Abramson, Lucia Allais, Arindam Dutta, John Harwood, Timothy Hyde, Pamela Karimi, Jonathan Massey, Ijlal Muzaffar, Michael Osman, Meredith Tenhoor, Culture, Politics, and the Built Environment* (Pittsburgh, Pa. : University of Pittsburgh Press, [2012], 2012).

^v Dutta refers to a 2004 paper – "Review of the Publicity Requirements for Planning Applications" – commissioned and published by the Office of the Deputy Prime Minister, authored by Arups. The paper, Dutta notes, is intended to "determine if the current statutory requirements for publicizing applications for planning permissions, listed building and conservation area consent are effective and offer *value for money*" (Author's italics)

^{vi} Reference Ewald on 'technologies of solidarity'

^{vii} Insert reference to Law's 'Magic Numbers' here.